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May 1, 2015

Ms. Michele Dermer  
EPA Region 9, WTR-9  
75 Hawthorne St.  
San Francisco, CA 94105

**Subject: Updated Evaluation of Annular Pressure-Temperature Relationship  
PG&E Test Injection/Withdrawal Well 1  
Permit No. R9UIC-CA5-FY13-1  
King Island, San Joaquin County, California**

Dear Ms. Dermer:

As required under Section D.6.c of Permit No. R9UIC-CA5-FY13-1 (the Permit), PG&E submitted an evaluation of the annular pressure-temperature relationship in Test Injection/Withdrawal Well 1 to assess the range of pressures that would be expected during normal operations and what changes might be indicative of a loss of mechanical integrity. That initial evaluation was based on the first 30 days of operating data and submitted to EPA as an attachment to the February 2015 Monthly Report, submitted by PG&E on March 27, 2015.

As a result of increased injection flow rates and temperatures from March 27 to March 30, annular temperatures increased above previously evaluated levels included in the February Monthly Report, and the annular pressure increased above the previously predicted range of fluctuation of 30 to 140 psia. An Updated Evaluation of Annular Pressure-Temperature Relationship was submitted to the EPA on April 1, 2015. It was noted in the updated evaluation that annular temperatures may be expected to be higher than originally evaluated when the full compression train is used and as ambient temperatures increase. The updated evaluation also indicated that annular pressure becomes more sensitive to temperature changes as the temperature increases. According to the April 1 updated evaluation, annular pressures are expected to remain between 30 and 600 psia during normal operating conditions. This is well below the maximum pressure applied during the internal mechanical integrity test performed on the well (2,500 psi), and is expected to change cyclically with diurnal temperature fluctuations.

In a letter dated April 17, 2015, the EPA commented "The acceptance of the proposed range of acceptable annular pressure fluctuations of 30 to 600 psia will be considered pending a review of the recorded annular

pressure versus temperature and injection rate data in future reports. In the interim, the upper limit of annular pressure can be set at 200 psia for compliance with paragraphs 6.b and 6.c and reporting a potential loss of mechanical integrity.” In a response letter, dated April 24, 2015, PG&E accepted the 200 psia annular pressure limit on a contingent basis, with the understanding that should annular pressures exceeding 200 psia be measured, a higher pressure limit may be requested, if supported by pressure and temperature data analysis demonstrating that the annular pressure exceedance is not due to a loss of wellbore mechanical integrity.

On April 27, 2015, at approximately 4:05 pm, the 200 psia notification limit on annular pressure was exceeded. Specifically, the following annular and injection pressures and temperatures were measured:

<b>Date</b>	<b>Time Range of Pressure Exceedance over 200 psia</b>	<b>Peak Annular Pressure and Time</b>	<b>Peak Annular Temperature and Time</b>	<b>Injection Manifold Pressure Range</b>	<b>Peak Injection Manifold Temperature</b>
April 27, 2015	16:05 – 23:59	238 psia @ 20:22	98.2°F @ 19:01	1865 – 1871 psia	115.3°F
April 28, 2015	00:00 – 01:24, 13:49 – 23:59	267 psia @ 18:49	99.6°F @ 15:47	1870 – 1875 psia	115.0°F
April 29, 2015	00:00 – 00:28, 14:10 – 23:59	267 psia @ 19:11	99.8°F @ 17:59	1873 – 1878 psia	113.5°F
April 30, 2015	00:00 – 01:33, 13:00 – 23:59	308 psia @ 20:01	104.1 @ 17:59	1876 – 1882 psia	117.2°F

PG&E notified EPA via email at 6:38 AM on Tuesday, April 28, 2015. At that time, we indicated that similar excursions would be expected over the next few of days as surface ambient temperatures remain elevated. We also indicated that we do not believe this represents a loss of mechanical integrity and that the pressures we experienced correlated well with the predicted annular pressure-temperature relationship presented in the updated evaluation report submitted on April 1<sup>st</sup>. We indicated that a review of the April 1<sup>st</sup> – updated evaluation report would be performed and that the updated analysis would be submitted to the EPA as required under Section D.6.b and c of the permit.

A review and updated evaluation of the annular pressure-temperature relationship for Test Injection/Withdrawal Well 1, dated May 1, 2015, is attached. This updated evaluation supports the conclusion that the observed annular pressure increases were solely a reflection of the operating conditions and not related to a loss of mechanical integrity of the tubing string or casing. The updated evaluation also supports the conclusion of the previous evaluation, that annular pressures are expected to remain between 30 and 600 psia during normal operating conditions. Based on the updated evaluation, a strong possibility of higher atmospheric and equipment operating temperatures as the test continues, and the high sensitivity of annular pressure to temperature, an annular pressure limit of 600 psi is considered appropriate. PG&E therefore requests that EPA grants an annular pressure limit of 600 psi.

PG&E will continue to monitor the annular pressures and temperatures during injection operations in accordance with the permit requirements, and will report any fluctuations outside this range, or any unexpected

pressure trends that do not correspond with the predicted annular pressure-temperature relationship, to EPA in accordance with Section D.6.b.

The updated evaluation of the annular pressure-temperature relationship for Test Injection/Withdrawal Well 1 is enclosed as one hard copy and as a PDF in a data CD. The document has also been uploaded to PG&E's Dropbox account, which can be accessed at the following link:

<https://www.dropbox.com/sh/mf2qnl5v016e78f/AABIm-gfjIKWppVCKe7hUgA6a?dl=0>

If you have any questions regarding this submittal or require additional information, please feel free to contact me at (415) 973-6270.

Sincerely,

A handwritten signature in blue ink, appearing to read "Mike Medeiros".

Mike Medeiros  
Manager, Renewable Energy Development

Cc: Mr. James Walker, EPA Consultant  
Mr. Michael Woods, Division of Oil, Gas and Geothermal Resources  
Ms. Anne L. Olson, Central Valley Regional Water Quality Control Board

Enclosures: Data CD with response letter and attachment  
Updated Evaluation of Tubing/Casing Annulus Pressure Excursions